An Examination of Coursera as an Information Environment: Does Coursera fulfill its mission to provide open education to all?

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Abstract

In terms of international education, this concept of online education seems to be a growing trend. Edxonline.org, Minervaproject.com and Udacity.com are all new massive online open courses (MOOC's) —education websites similar to Coursera offering students the ability to receive the best education from elite universities entirely online. In this digital age, students are seeking ways to receive an education that is convenient and fits well with their lifestyles, but is also credible. The most tantalizing promise of a company like Coursera is the role it might play in improving education for the world's have-nots: high school dropouts, the global poor, and those less able to self-teach (Kamenetz, 2012).

Keywords: accessibility, information environment, online education, online learning, open education, open education movement, open education technology, open online courses (OOC's), massive open online courses (MOOC's), learning management system (LMS), virtual learning environment (VLE), web-based learning tools

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When the Internet became widely available to the general populace in the mid 1990s, higher education immediately recognized the untapped potential of virtual space as an effective and dynamic addition to the traditional model of university instruction. The initial foray to creating a new teaching environment involved rather rudimentary frameworks and significant limitations with communicating in virtual space. In most instances students were instructed to Telnet (or whatever their Internet Protocol might be) into the network server in order to access a virtual MOO (Multi-User Domain – Object Oriented) classroom through any LAN (Local Access Network) connection on campus, to discuss course content with their classmates and professors. This provided synchronous communication of ideas, but this early use of virtual education was mediated by a single line text-based interface. The tools and skill-set needed to access this virtual space were basic enough for anyone who was willing to explore.

Now, nearly twenty years hence, the development and growth of open educational technology initiatives across the world have expanded dramatically. A more interactive approach to online education has taken off within the last couple of years given the booming global popularity of massive open online courses (MOOC's). The potential to create and utilize complex technologies to facilitate open collaborative learning is the reality of our present moment, not the distant future. Developers and educators within higher education have come together to create online learning platforms that are encouraging new and more dynamic ways to engage with ideas and construct one's knowledge.

Coursera is a social entrepreneurship company that partners with the top universities across the globe to offer free courses online for anyone to take. Its mission is to educate millions of individuals worldwide by offering courses on various topics from elite universities; professors have the to capacity to teach 30,000 or more students at once thanks to an instructional platform supported by robust computing power and complex infrastructure. This information environment can serve any student in the world, provided that they have an Internet connection. Aided by technology, students are able to watch lectures from home, rather than a lecture hall, and Coursera hopes to make this student experience more collaborative and interactive for those who would not otherwise have the opportunity to receive an elite education.

Striving to make the platform distinct from other types of MOOC's, the Coursera team sought out sound pedagogy for effective learning methods, and then translated the concepts into processes that could be built into the design of the platform itself. The following pedagogical concepts have been shown to help students learn more efficiently and thoroughly: efficacy of online learning (U.S. Department of Euducation, 2010); the importance of retrieval and testing for learning (Karpicke & Roediger III, 2008; Karpicke & Blunt, 2011); mastery learning (Bloom, 1984); peer assessments (Robinson, 2001), (Snow, 2008); and active learning in the classroom (Delauriers, Schelew & Wieman, 2011).

These principles are foundational to the ways in which students engage with the assorted learning and networking tools that Coursera provides as part of their personal learning environment. The videos are approximately eight to twelve minutes, with each unit presented as a coherent concept. At specific points the video pauses, and students are prompted to answer questions about the material before they're able to proceed with the video. Students have access to online discussions, Q&A forums, high-quality readings, and can submit writings, contribute to

the course wiki, take quizzes, and conquer exams. Given the immense size of these courses, peer review grading is employed for many courses based in the humanities. The platform provides the opportunity for meaningful exchange between faculty and peers in forums and discussion boards; although the extent of that contact varies according to the professor's preference and is usually addressed at the start of the course.

As a new venture operating for a little more than six months, no "best practices" have yet been established (Gose, 2012). As a result professors adjust course materials to their pedagogical purposes, which lends to some variation across disciplines. Dr. Gautum Kaul a professor at the University of Michigan, taught "Introduction to Finance" for Coursera; and though his video lectures are as long as twenty minutes he states, "You don't want to break up something that can't be broken up" (Gose, 2012). Dr. Al Filreis, Kelly Professor English and Director of the Kelly Writers House at the University of Pennsylvania, teaches a course on modern and contemporary American poetry known as ModPo on Coursera. The pedagogy of teaching poetry is not conducive to the lecture format. Instead he conducts group discussions with six or seven Penn students in a seminar style format, which are recorded and then posted to the ModPo page (Filreis, 2012).

In the "Writing in the Sciences" course offered by Stanford University, instructors facilitate extensive discussion forums in which students are able to offer feedback to one another on various topics pertaining to the course. Here, students also have the ability to form study groups by native language or time zone. Coursera sends pre-course surveys to students asking what they expect to get out of the course and what they have experienced in previous science courses. This survey is just one of many methods that Coursera employs to collect data about students' learning process, which is ultimately used to improve aspects of the virtual learning

environment on the whole. Through their multi-faceted approach, Coursera is poised and ready to change education across the globe with innovative methods to enrich virtual learning environments.

While participants in Coursera typically do not earn actual college credit, the experience does have an impact on the students' lives. According to Andrew Ng, founder of Coursera, many students have obtained employment or received job promotions as a direct result of having these courses listed on their resumes (Gaylord, 2012). This information environment along with other MOOC's demonstrate how technology is changing the way we as individuals choose to pursue education.

Coursera has developed an honor code and terms of service similar to those of traditional universities that students who enroll in courses through Coursera must follow. Students signing up for courses agree to abide by the rules of the honor code stating that they will only have one account, only submit their own work, and will not engage in activities that dishonestly improve their scores or affect the work of others. Coursera also provides students with comprehensive information regarding terms of use and privacy policies. The other online entities like Coursera provide students with similar disclaimers, term of use, honor codes, and privacy policies. These policies hold the students responsible for their education and articulate the MOOC's expectations of the students and faculty. This is particularly important due to the nature of online education, and the common critiques of this new style of course delivery.

Together these policies and provisions make up the company's information policy, which essentially defines the parameters of participation, use, privacy, and terms of service. Coursera has developed guidelines for the use of information in their particular environment. These guidelines typically serve as a reference for both the users and the entity creating the guidelines.

In this type of information environment, it is important to have guidelines for the distribution, dissemination and creation of information found within the environment. Coursera must consider distribution and dissemination as they relate to copyright and patents because it deals with outside partners and is offering access to information in an open access forum. Coursera has guidelines governing what information they will make accessible to the public, and information that they will consider classified. Policy guidelines operate as safeguards for the organization should others have questions about the methods in which they conduct their organization.

In terms of business activities, in April of 2012 the founders, Andrew Ng and Daphne Koller, launched Coursera with sixteen million dollars in venture funding. Investors in the venture knew they were taking a high risk with this high-potential start-up company. This seems to be true for most other websites that offer online education. Udacity.com was funded by venture capital, and their courses are free to students at this time. The Minerva Project differs in that the tuition is $20,000 per year for students to attend. Coursera, Udacity and Edx could potentially start charging for their services in the future, although none of them do so as of yet. Eventually, Coursera will need to turn a profit for their investors, and they could potentially charge a fee for certification or for job placement in order to create revenue. Coursera could also potentially charge students for a certified copy of a non-credit letter (Kamenetz, 2012). This would introduce a premium model, suggesting that students enjoy the classes for free, but pay something for proof that you took the course. However, generating revenue does not seem to be of concern to the founders, their investors are more interested in changing the world. “As long as people want to use the resources they are offering, the revenue will be found” (Kamenetz, 2012).

The Coursera funders include John Doerr, who is a partner for Kleiner Perkins Caufield & Byers, and Scott Sandell, who works with New Enterprise Associates. As with many venture

capitalists, these funders recognize that it could be years before they recoup their investment. This makes attracting funders difficult, and like a lot of online enterprises in their early days, Coursera has captured more eyeballs than revenue (Kamenetz, 2012). Even though they are not generating revenue, Coursera has been the first to offer top courses in concentrations like the Humanities and Social Sciences, and they have partnered with top universities like, Stanford, the University of Michigan, Princeton, and the University of Pennsylvania. Within only a few short months this interesting new company has grown an online business comprised of only two people into one with over twenty staff and personnel working in engineering, design, course development, and business development. As leaders in the new frontier of online education, Coursera offers job seekers the opportunity to make free, world-class education a possibility for people worldwide, while also working closely with professors from elite universities, earning competitive wages, enjoying medical and dental benefits, and interacting with guest speakers who are leaders in their respective fields.

Literature Review

Given that Coursera is a new initiative, and grew out of developments within the pedagogy of open educational technology, the first section of this literature review will examine the evolution of the pedagogy of open education and online learning. This will provide a contextual understanding of the developments and changes that have occurred in online education, and the confluence of events and research that led to the creation and popularity of MOOC's, and as a result Coursera. The second half of the literature review will focus specifically on Coursera, the extent of its impact, and range of anecdotal evidence from students and instructors.

The edited collection *Opening Up Education: The Collective Advancement of Education Through Open Technology, Open Content, and Open Knowledge* by Toru Iiyoshi and M.S. Vijay Kumar published in 2008, could be considered a clarion call to other like-minded individuals who were dedicated to improving access, content, and movement towards improvements in pedagogy concerning higher education through the use of open educational technology. "Despite the diversity of tools and resources already available… educators have yet to take full advantage of shared knowledge about how these are being used, what local innovations are emerging and how to learn and build upon the experiences of others." (Wisher, 2008). This collection of essays grew out of a day long meeting of participants who gathered together to discuss major concerns, questions, and visions for their conception of open educational technology and the potential for application across a variety of institutions, foundations, associations, and projects.

Comprised of individuals who have led major initiatives and projects within higher education and major foundations, the authors in this collection were in some capacity "involved in aspects of design, development, adoption, policy making, standards setting, or evalution of open technologies used in higher education teaching and learning settings" (McGrath, 2008). Each essay examines the open educational technology initiatives that they spearheaded in their fields, and reflections and discusson about the various problems that they encountered, and what they learned moving forward, in their continued efforts to to create dynamic envrionments that are open-source and online.

> *Opening up Education*" argues that educators must develop not only the technical capability, but also the intellectual capacity for transforming tacit pedagogical knowledge into commonly usable and visable knowledge. (Wisher, 2011).

A few of the essays in the collection concern the role of technological tools, working with LMS platforms to explore new structures of interaction, and the importance of injecting "social character" back tino the educational technology.

> Open educational technology's distinguishing features cluster around aspects of visibility, social interaction, shared meaning-making, and unfettered access to resources. Educational activities made possible in open educational environments are characterized by the opportunities for collaborative participation and creative exchange (McGrath, 2008).

The serious concerns that they address include: "emphasizing design and evaluation [in open educational models]; ....identify institutional and cultural barries to the advancement of open education" (McGrath, 2008); identify and "analyz[e] the organizational processes involved"; and problems related to scale, particularly if striving towards "large-scale, cross-institutional open education technology projects" (McGrath, 2008).

The open educational movement had been developing from the early 2000s, but not in the way that the contributors to *Opening Up Education* felt was sufficient to create effective learning environments. Open educational resources (OER) really began to take shape when MIT proposed and developed the OpenCourseWare platform eleven years ago to make educational materials from undergraduate and graduate programs available to anyone for free (Ableson, Miyagawa & Yue, 2012). Over the years it has generated considerable traffic, and even led MIT to collaborate with worldwide institutions to create the OpenCourseWare Consortium a few years later.

There is no doubt that the availability of these resources can be beneficial for many individuals who want to learn. Much of the literature evaluated examined the pedagogy of online education in addition to open educational precepts. While the dynamics are different of both

OER and online education through a LMS, much of the pedagogy consulted emphasizes the confluence of three important factors: knowledge of the pedagogy of online learning; web-based tools that will facilitate learning and an intuitive interface to LMS platform; and the instructor's ability to meaningfully integrate the course content to create an effective learning environment. (Lin, Dyer & Guo, 2009); (Wijekumar, 2008); (Tu, Sujo-Montes, Yen, et. al., 2012).

In 2008, the same year that *Opening Up Education* was published, the second open online course (OOC), the predecessor of the MOOC's, was made available during the fall semester at the University of Manitoba. Entitled "Connectivism and Connective Knowledge" the class was taught online to local students but also offered to anyone in the world for free. Though it was not the first official OOC it utilized a personal blog and a map building tool; "more than 12 different tools and technological environments were used, from LMS's (Moodle) to 3D environments (Second Life)" (Fini, 2009), and attracted close to 2,000 students (Fini, 2009).

What distinguishes standard online education from MOOC's is that online education has typically been a self-motivated enterprise. Unfortunately, the design of the LMS and clunky interface that is typical for online courses emphasizes a sense of going it alone and not really having a shared educational experience. On the other hand MOOC's function like a real class with a start date, readings, assignments throughout the week, participation in discussions, and peer assessments. It is occurring in real time for those who follow the schedule, but it also allows people to determine their level of interest, and gauge their involvement accordingly. For those committed to completing the course, they are engaging on a level comparable with most face-to-face lecture classes, once one considers the impact of the pedagogically informed design, and technological tools used to enhance communication and expression. Online course design is an essential component to an effective educational experience when the designer is aware of the

pedagogical foundations, and how to interpret those foundations into actual processes within the VLE (Karen, Daniel, Leonard et. al. 2012).

Our contemporary lives require an assortment of skills, and educators and designers are recognizing that building that same versatility into online courses engages the user than inhibiting the user. “In the context of informal education, the integration of multiple and heterogeneous environments and tools may represent the starting point of a learner’s knowledge construction quest” (Fini, 2009). Changing the structure and means of how information is accessed and how one is exposed to new ideas through iterative processes, can provide new insights for students. As Siemans (2009) says “[MOOC’s] are examples of shifting from a content-centered model towards “socialization as information objects” (Fini, 2009). The potential for MOOC’s is limitless since the dynamic and feedback depends on the various networks of people and materials with which one is engaging. Fini writes, “..the real potential of an [M]OOC is to be found in the mergence of learning networks among participants in a many-to-many relationship, rather than the traditional one-to-many model of interactions between a teacher and his or her students” (2009).

Throughout all of the articles that deal with Coursera directly, the program is highly respected and appears to be the best among similar programs. However, there are many critics that do not support Coursera because the program is not accredited. Regardless, Coursera fulfills its role as an information environment because it allows students to learn in an academic setting that breaks conventional standards. With Coursera’s designed platforms and video lectures from professors, students around the world can gain more knowledge into specific subjects that interest them. Coursera is free which also helps to educate those who do not have the money to

afford tuition at a traditional college or university. Coursera also benefits those who already have degrees but would like to learn more skills.

On YouTube, a number of videos are posted about Coursera and other similar open education programs. However, one in particular stands out entitled, "Computing Conversations: Daphne Koller and Coursera." Daphne Koller, a founder of Coursera, explains what Coursera is and how it can better the future of those who use it. Koller begins with stating,

> Our company's mission is to educate the world and we believe that education is the great equalizer in that many of the world's problems can be made a lot better if more people had access to education. And that includes problems like unemployment, hunger, and even extremism (Severance, 2012).

Koller credits YouTube with being an inspiration for her to create a free open education program based upon a video connection (Severance, 2012). Koller believes that global studies groups, which Coursera courses provide, are one of the most important features of the program (Severance, 2012). She also adds that Coursera is revolutionary in the regard that it is educating people around the globe and that, due to the study groups, people from different countries are all sharing ideas and are being connected as a human race (Severance, 2012).

In another video, available from TED Talks, entitled "Daphne Koller: What We're Learning From Online Education," she promotes Coursera to the Internet community. Koller claims that,

> In some parts of the world, for example South Africa, education is just not readily accessible. In South Africa the educational system was constructed during the years of apartheid for the white minority and, as a consequence, today there is just not enough spots for the many more people who want and deserve a high-quality education" (TED, 2012).

She also states that these problems are not just isolated in foreign countries, but these problems also exist within the United States (TED, 2012). She very interestingly adds,

> So to understand this, let's look at one of those classes - the Machine Learning class offered by my colleague and co-founder Andrew Ng. Andrew teaches one of the bigger classes at Stanford - the Machine Learning course, which has 400 people enrolled every time it is offered. When Andrew taught the Machine Learning class to the general public it had 100,000 people registered – so to put that number in perspective - for Andrew to reach that same-sized audience he would have to do that for 250 years (TED, 2012).

Aside from the incredible quality of the courses, in sheer numbers alone Coursera is making an impact on a large scale.

In NPR's article, "Online Education Grows Up, And For Now, It's Free," NPR reporters discuss how the program was created and what kind of results the program has had so far in its short debut. This article showcases the wide variety of people who are using Coursera. A 22-year-old student, from Kazahkstan, named Askhat Murzabayev is taking Stanford's Machine Learning course because his university does not offer classes in artificial intelligence ("Online Education Grows," 2012). He passed the course and received a certificate of completion from Stanford University ("Online Education Grows," 2012). In Kazahkstan, the certificate gave him an outpouring of job offers and now he works for Twitter there ("Online Education Grows," 2012). This experience highlights the shift in our society to a knowledge-based economy where the education itself has value, and not the credit or diploma. As Koller explains,

> "For the students who never, ever would have had access to this kind of quality education from a place like Penn or Princeton or Stanford, they now have access to

> something…It's not the same as the experience of the on-campus students, but it's a heck of a lot better than what they had before" ("Online Education Grows," 2012).

Andrew Ng believes that Coursera will never replace the four-year university education, but it is a wonderful tool. "'Anecdotally, we've heard of many students getting jobs or receiving promotions as a direct result of having these courses on their résumé,' says Ng, who heads Stanford's Artificial Intelligence Lab. Silicon Valley companies in particular have reached out to the students who received top marks in Coursera's computer science classes…" (Gaylord, 2012). "With student consent, Ng said, Coursera has begun making introductions to a few employers (Anderson, 2012). This was the case for Askhat Murzabayev and, potentially, for the other 1.5 million students enrolled in Coursera courses ("Online Education Grows," 2012).

Besides Coursera, there are many other MOOC's that exist. All of these MOOC'S are changing the ways in which the world believes traditional education to be. However, Coursera certainly seems to be the most popular among users and professors alike. Brian Caffo, a professor from John Hopkins University, has seen the rise in popularity of his courses since he began to offer them on Coursera (Anderson, 2012).

> On the first day, the forum lit up with greetings from around the world. Heady stuff for a 39-year-old associate professor who is accomplished in his field but hardly a global academic celebrity. 'I can't use another word than unbelievable,' Caffo said. Then he found some more: 'Crazy . . . surreal . . . heartwarming'" (Anderson, 2012).

One course in particular, a public-health course, would have a typical enrollment of 70 at the university, but now, on Coursera, the course has an enrollment of over 15,000 (Anderson, 2012).

Many critics argue that Coursera is not beneficial because it offers no degree and is not accredited. However, Coursera is breaking enough new ground, with positive results from students and professors, that certain higher learning institutions are changing their policies regarding credits. One instance is Antioch University in Ohio "that will enable tuition-paying students to take Coursera courses for credit at that school" (Anderson, 2012). Other universities are currently in negotiation with Coursera to provide courses to students in a way that the Coursera platform would be used while the students receive credit (Young, 2012). The University of Washington is actively pursuing this model, as are several community colleges across the country (Young, 2012). Even states are now reevaluating their laws in order to have MOOC's available to those who wish to learn online. Minnesota has ha a decades-old law requiring all colleges and universities to register with the state before they are allowed to operate (Ehrenfreund, 2012). According to a spokeswoman for Andrew Ng, the law would require each school in partnership with Coursera to register separately with the state of Minnesota before state residents could participate in the online classes. While unusual, the law is apparently not unique among states. If participating universities had to go through such a process for multiple states, it "could truly become an obstacle to online education" (Ehrenfreund, 2012). However, quite recently Minnesota agreed not to pursue any legal enforcement due to a large vocal opposition from the Internet community and Minnesota residents as well as the fact that Coursera is a legitimate Internet learning site (Ehrenfreund, 2012).

The U.S. Department of Education has published information, in the article "Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies," regarding the results of studies done within the last five years on distance learning versus face-to-face learning. "Online learning has become popular because of its

potential for providing more flexible access to content and instruction at any time, from any place. Frequently, the focus entails (a) increasing the availability of learning experiences for learners who cannot or choose not to attend traditional face-to-face offerings, (b) assembling and disseminating instructional content more cost efficiently, or (c) enabling instructors to handle more students while maintaining learning outcome quality that is equivalent to that of comparable face-to-face instruction" (Evaluation of Evidence-Based, 2010). These results can be directly related to the operations of Coursera and similar MOOC's. On a further note, the U.S. Department of Education also found that, "When used by itself, online learning appears to be as effective as conventional classroom instruction, but not more so" ("Evaluation of Evidence-Based," 2010). This type of validation from a government institution on a nationwide scale is extremely important for the progression of MOOC's.

One of the ways in which Coursera has managed to keep its high levels of enrollment is due to the design of the platform itself. It is user-friendly and encourages students to interact with one another through a variety of different formats. Within the online courses, students can interact with one another through discussion boards and virtual study rooms. Al Filreis, a professor of poetry at the University of Pennsylvania, claims that there is no way he could possibly grade all of the papers for his Coursera poetry course, but he is more interested in seeing the ways in which the students interact with one another by their comments in the discussion boards (Henn, 2012). "In his class this fall, Filreis will discuss poetry with a small group of students while potentially thousands make comments online. Coursera is building a system like Yelp that will let these students value each others comments; the most valued and respected will rise to the top" (Henn, 2012). Filreis claims that within just one Coursera class, he could reach more students than he ever has throughout his whole career combined (Henn, 2012). We have

contacted Professor Filreis and will include more of his comments in the data analysis section of this paper.

Perhaps the most important learning tool within the field of MOOC's, and especially Coursera, is the use of video lectures. The majority of courses available from Coursera use weekly prerecorded videos. The article, "Improving Online Social Presence Through Asynchronous Video," by Jered Borup,Richard E. West, and Charles R. Graham focuses on student responses to instructor videos. Borup, West, and Graham (2012) found that, "The results showed a variety of positive responses. In addition, the majority of students stated that video communication helped them to develop an emotional connection with their instructor and to know that they could rely on him for help. Some students also said that the fidelity of the video contained a type of visual self-disclosure that helped them to get to know their instructor." This is extremely important for Coursera when thousands of students are enrolled in just one individual course.

Though the future of Coursera is still up for speculation, they seem to be taking a strong lead in the efforts to change the traditional landscape of education. Over a span of six months Coursera has managed to provide hundreds of thousands of people with an opportunity to pursue and engage with ideas and individuals, and through that process construct and add to their knowledge. Professors and students involved in MOOC's, such as Coursera, see it as a major opportunity to share information and to create a global learning environment. "Hijazi, 23, a digital-marketing consultant in Beirut, signed up for dozens of MOOC's. 'It helps you meet people from all around the world and actually gives meaning to the term 'global classroom,' Hijazi wrote, 'where tens of thousands of students from all countries work together and get to know each other" (Anderson, 2012). Koller and Ng, Coursera founders, remain confident in their

program as Koller states, "By providing what is a truly high-quality educational experience to so many students for free, I think we can really change many, many people's lives" (Henn, 2012).

Methods

In order to gather data about Coursera, we have opted for a dual approach, drawing on both qualitative and quantitative methods. First, to obtain qualitative data, we enrolled in courses in various subject areas, and gained access to the virtual classroom environment, thus allowing us to explore and observe the interface and its features, which constitute the bulk of the teaching environment. Second, we emailed the Coursera staff to inquire about what numbers they could provide about overall enrollment and course completion rates to begin our quantitative examination. Finally, to gather our quantitative data, we examined all the course descriptions to determine how accessible the courses are for the average student with respect to the professor; requiring outside materials, technology, or educational background and skills; and time demands. Additionally, we recorded the disciplines under which each course was cross-listed, in order to permit analysis of the results by discipline.

Although the course descriptions generally follow the same template—an introductory video from the professor, a general description of what the course is about, and a syllabus breaking down the topics to be covered—not every listing touches all of these points; we recorded the presence or lack thereof of each of these elements as a simple yes/no answer. Although the course descriptions vary considerably in the depth of the information they offer, the difficulty of determining a benchmark to measure them by was prohibitive. Syllabi similarly varied in detail, and in some cases the section labeled as the syllabus did not provide any of the expected information; as such, we opted to define the syllabus as a week-by-week listing of the topics that the class will cover, and any course description that failed to present that information

was recorded as lacking a syllabus, even though some claimed to contain one. As the course description is the only information available to a student before choosing to enroll in a class, the information provided here is critical to helping students make choices about what classes interest or may benefit them the most, and a detailed description can make or break a decision.

The second set of variables we examined in the course descriptions was the resources necessary for completion. Although the majority of each class is self-contained by Coursera's classroom interface, some classes make use of elements outside of that interface, the availability of which might be an obstacle for some students who wish to enroll. We split this into several categories. First, the use of external websites and software; although all students enrolled via Coursera may be assumed to have some form of computer access, an Internet connection, and a reasonably up-to-date web browser, some classes require the installation of other software to complete assignments, which represents a potential cost barrier or requirement of permission from the computer's owner. As such, we examined the presence of additional software requirements, and whether the software was specified to be open-source or otherwise freely available. Second, we considered assigned readings, whether all texts were provided within the course or whether external textbooks were required, and whether any additional texts were open-source, free online, or required a purchase. Third, we examined prerequisites; not all courses taught through Coursera are entry level, and some require a level of education not available to everyone in order to understand the work. Fourth, we recorded the estimated workload, which most course descriptions express in hours per week—an important consideration for those already working or caring for families. These variables, when combined, are intended to offer a broad picture of the overall accessibility of Coursera's classes; although the system is designed to offer a more feasible alternative to the time and expense of traditional college education, it is

difficult to say whether it succeeds in putting these courses within reach of a broad audience without considering the general pattern of requirements to successfully complete the average course.

Data Analysis

As of November 2, 2012, Coursera is offering 198 courses online from 36 universities. Coursera divides these courses into 19 different categories that are comparable to academic disciplines, for example: Biology & Life Sciences, Education, and Mathematics. We also looked into edX and Udacity, which are similar web-based delivery platforms for higher educational content; however, we did not collect data on them to the same extent that we did for Coursera. EdX is offering nine courses currently from three universities (MIT, Harvard, and Berkeley), and Udacity is offering 18 courses. Udacity does not appear to be affiliated with any institutions of higher education, but, for example, some of its professors teach at the University of Virginia, Saarland University in Germany, or work in industry. EdX's courses focus on chemistry, computer science, and research methods. Udacity's courses are also heavily focused on computer science and physics and mathematics. Coursera has the most extensive and widest-ranging course offerings of these three MOOC's, including courses in the Humanities, Social Sciences, and Music, Film, and Audio Engineering categories.

We began by looking at Coursera's courses listed in each category. Many courses are cross-listed in two or more categories, so by reviewing each category, we found instances of 293 course listings. We counted how many courses there were in each category, and then we broke that down between how many courses were listed in only one category, in two categories, and in three or more categories. We recorded our findings in a bar graph. The vertical axis contains the number of courses listed in that category overall, and the horizontal axis names the category. The

blue portion of the bar shows the number of courses listed in only one category, the red portion shows the number of courses listed in the first and one other category, and the green portion shows the number of courses listed in the first and two or more categories. For example, there are 25 courses listed under Biology & Life Sciences. Six of those courses are only listed under Biology & Life Sciences, 15 are listed in Biology & Life Sciences as well as one other category such as Food and Nutrition or Medicine, and four of those courses are listed in three or more categories. Our findings are shown in Figure 1.

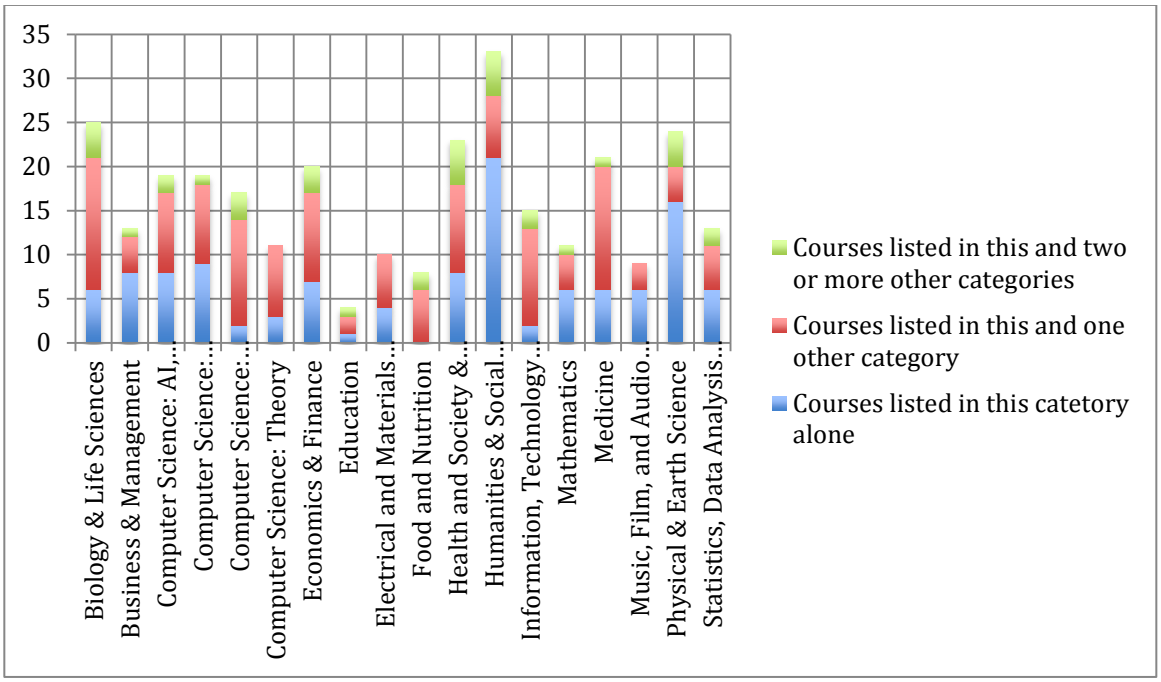

Figure 1

Neither edX nor Udacity categorize their courses by discipline, so we are unable to do a comparison. In Coursera, we found that the majority of courses are listed in two or more categories. Since the categories roughly follow divisions in academic disciplines, this finding illustrates the interdisciplinary nature of these courses. We did not include the results pertaining to disciplines since they did not support our inquiry into Coursera.

Next we eliminated the duplication of courses in our data spreadsheet so that we could look at the data from the 198 courses listed on the website, instead of all 293 instances of courses. We wanted to see if there were video introductions for each course, whether there is a syllabus, whether outside websites or software is required for a course, whether other course materials are required, and whether some sort of prerequisite or background is required to take the course.

We also noted, that like edX and Udacity, Coursera's course descriptions have embedded social media widgets so that students or potential students can "like" them on Facebook, tweet about them on Twitter, and +1 them in Google+. See figures 2 through 4.

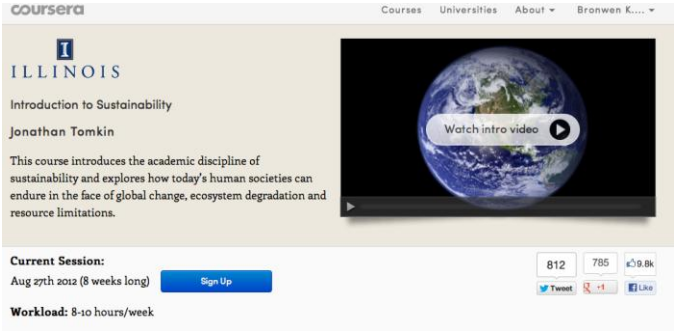

Figure 2

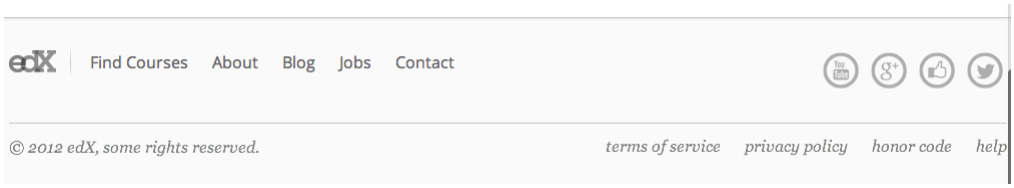

Figure 3

Figure 4

In Coursera, we found that 100% of courses included some sort of description. In the course descriptions, we found that 158 or 80% of courses included an introductory video. These videos are posted on Coursera's channel on YouTube.com, and as far as we could tell, all of them feature the professor.

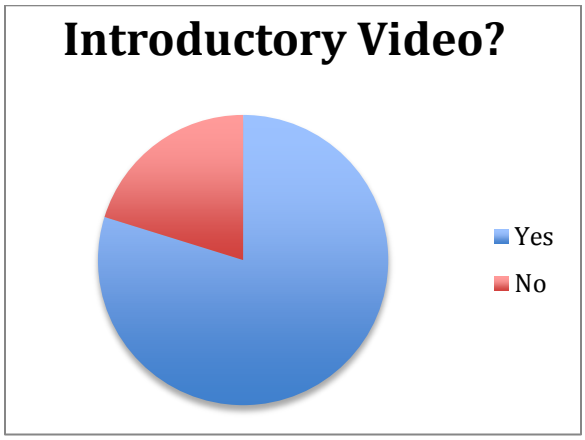

Figure 5

The 40 courses, or 20% of courses, that did not post a video instead included a graphic in a rectangular frame that usually had something to do with the course content, although usually not much more than a clip art image. See figures 6 and 7.

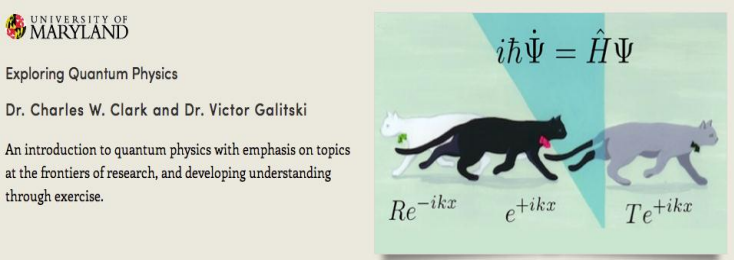

Figure 6

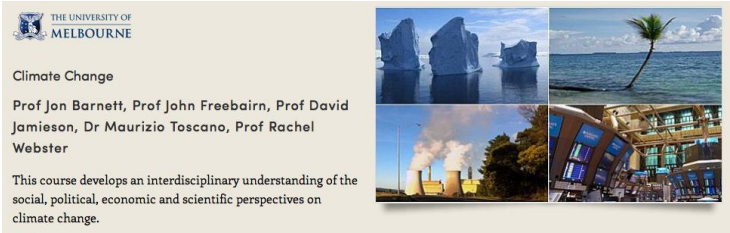

Figure 7

EdX and Udacity courses also include videos published through YouTube. These videos provide first contact with the professor and the course content in a much more interactive way than a static description in a traditional course catalog. Unlike course catalogs, which are proprietary, these videos are publically available.

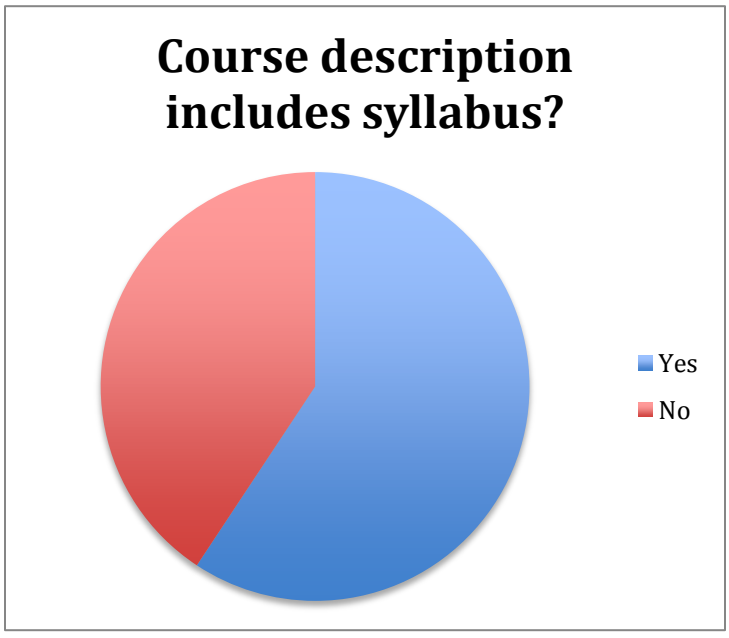

Figure 8

Next, we found that 118 or 59% of course descriptions included a syllabus. 81 courses, or 41% of courses, did not include a syllabus. It is important to note that the syllabus may not yet have been posted for some courses that are not yet in session. It is also important to note that course syllabi are posted within

the course interface and accessible to a student once they enroll. See Figure 7. This syllabus may or may not match what is available in the course description.

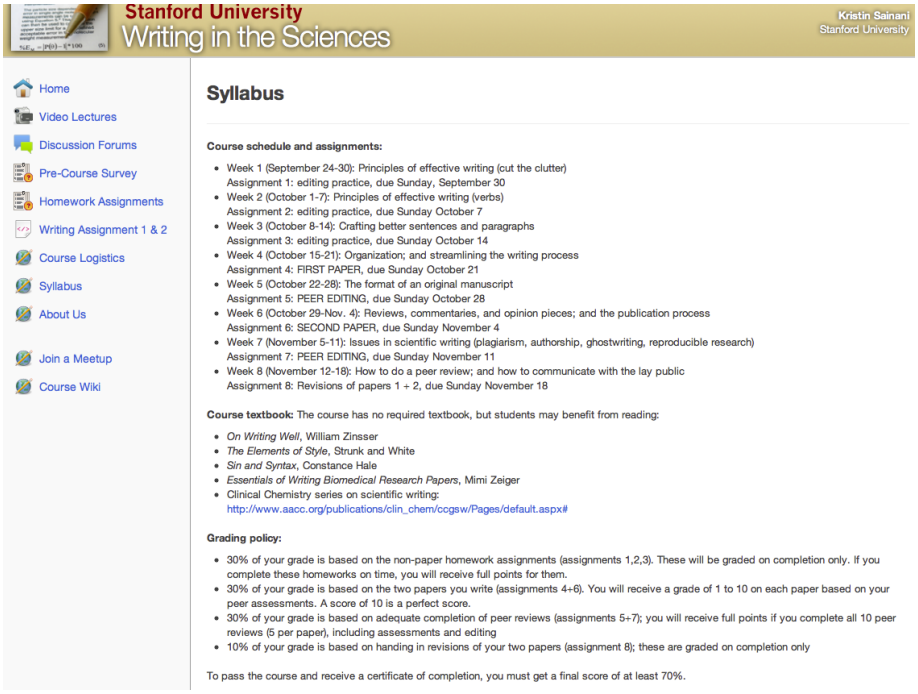

Figure 8

We found that the majority of courses included a syllabus in Coursera. This was also true for 100% of Udacity courses; however, the syllabi were generally bare-bones representations of what the course material covered. Only one of nine edX courses, Artificial Intelligence, included a syllabus in its course description.

Next, we considered whether outside software or websites are required to participate in a course. We found that 142 courses, or 71%, did not require anything beyond the assumed computer with Internet access and a browser. An additional 13 courses, or 7%, suggest optional outside sources that are freely available and online. 39 courses, or 20% did require outside websites or software; however, these sources were also freely available online. These sources are either freeware or open-source, and some examples include Java, Python, and Octave.

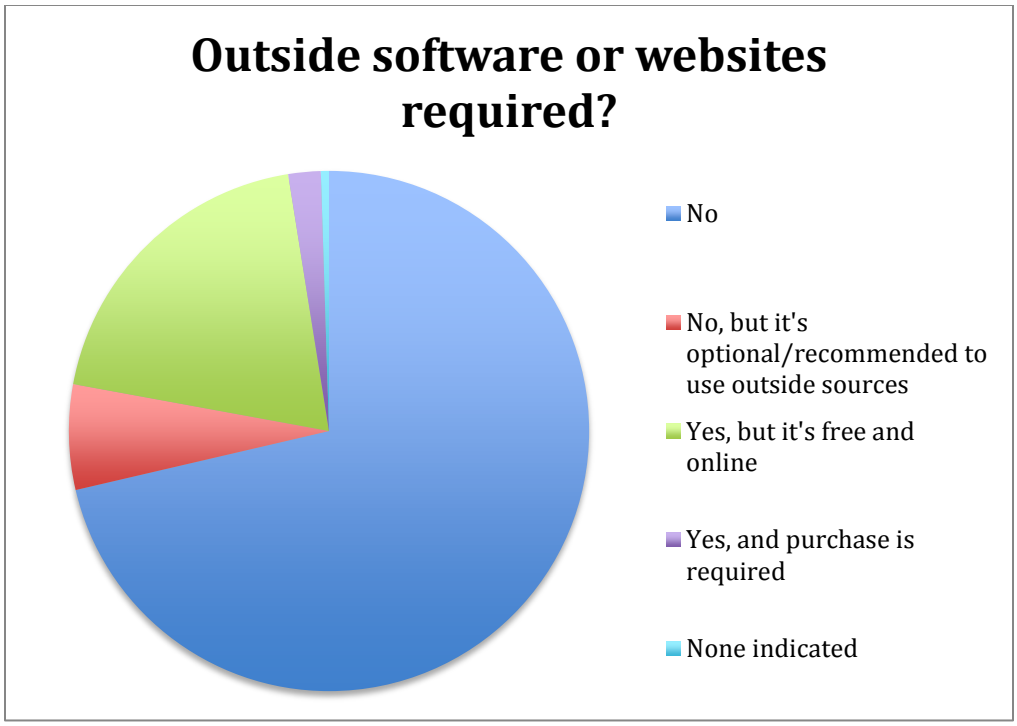

Figure 11

Only 4 courses, or 2%, require that students pay for software that is outside the Coursera environment, and only one course did not indicate whether outside software or websites would be required. Overall, we found that 97% of courses are either self-contained or provide a free option for the required materials.

We then considered whether any course materials are required. Materials can include a textbook, computer microphone, a guitar, art or graphic design supplies, or cooking utensils and a kitchen!

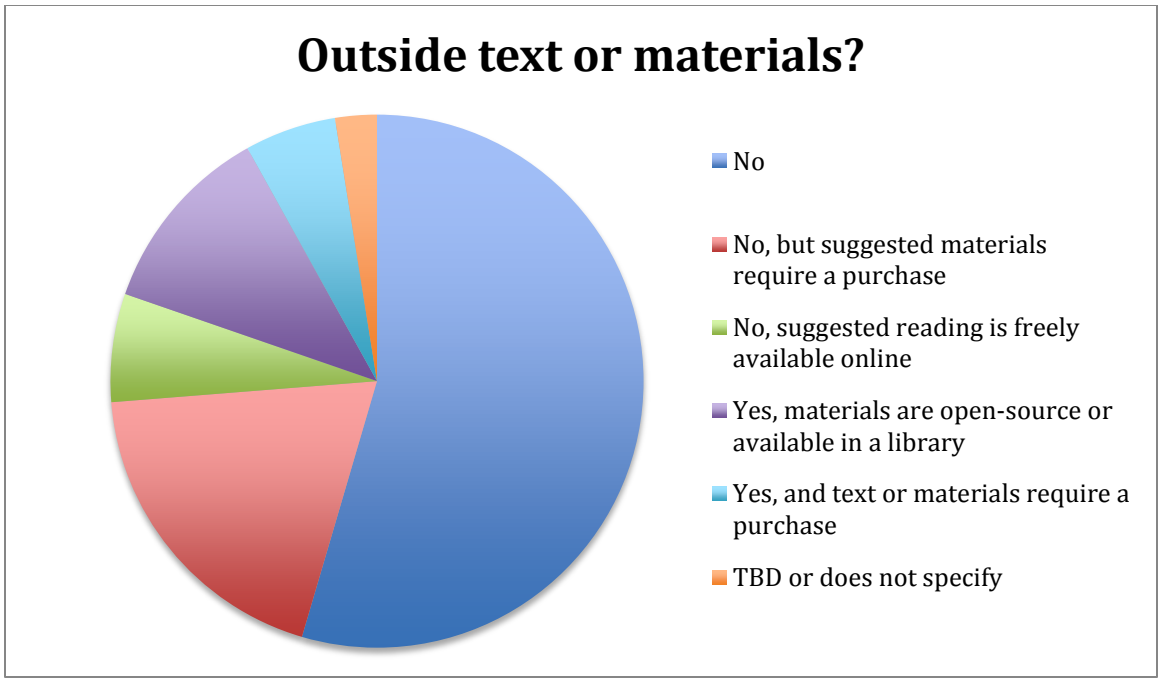

Figure 12

We found that 108 courses, or 55%, do not require purchase of outside text or materials, and an additional 36 courses, or 19%, require or suggest the use of open-source textbooks or other freely available online resources. 38 courses, or 19% suggest purchasing a text or other materials, and 11 courses, or 6%, require purchasing a text or other materials. Only five courses, or 3%, did not require outside materials or did not specify whether they would be required. According to Udacity's FAQs, "there are no required textbooks for [these] courses, and the course content does not follow any textbook." (2012). In contrast, four out of nine edX courses recommend but do not require textbooks that have a price, and a fifth course offers the use of a free online text.

We then looked at whether it was necessary to have a background in the field or some prerequisite courses.

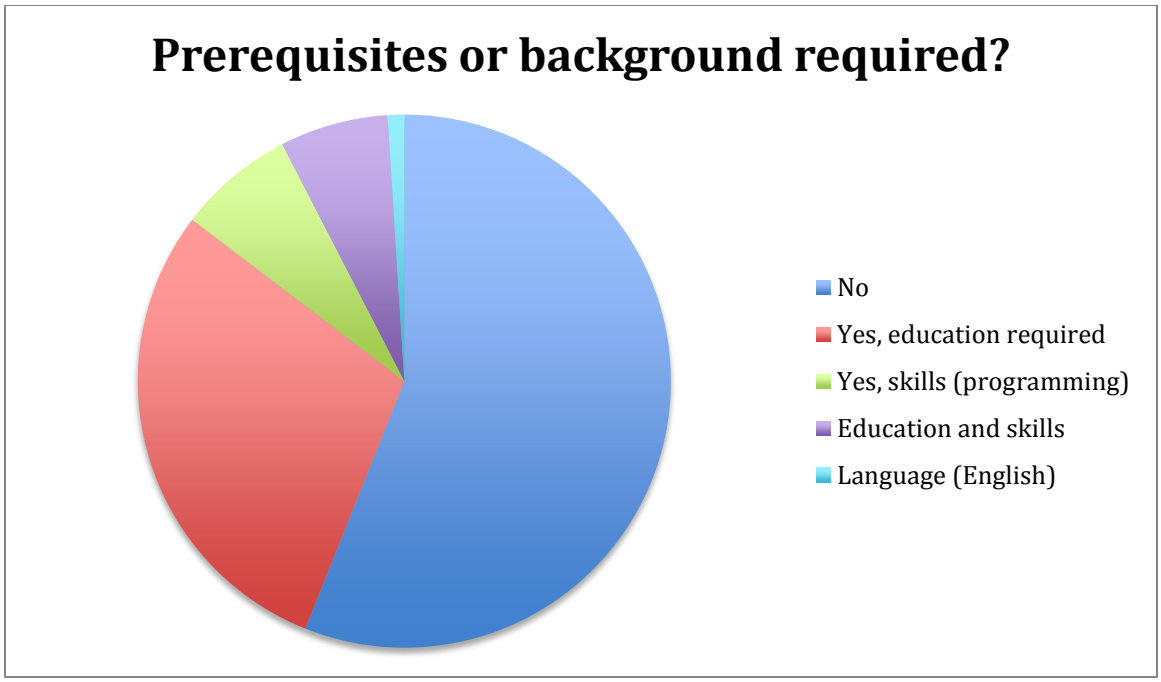

Figure 13

We found that 111 courses, or 56%, did not require any sort of background or prerequisites. Sometimes the professors listed a requirement of having interest in the field or curiosity for the subject matter. 58 courses, or 29%, required some sort of background. This could include anything from elementary algebra, to high school, to college-level calculus. 14 courses, or 7% require some level of computer programming skills, and another 13, or 7%, require a combination of education and programming skills. Two courses, or 1%, listed English as a prerequisite. We should also note that one computer programming course, Introduction à la Programmation Objet, appears to be taught entirely in French. Using Google Translate, we were able to find that "[this course] does not presuppose prior knowledge." Since edX and Udacity's course offerings lean toward computer programming and the sciences, most of them require at least undergraduate-level math or science knowledge.

Finally, we looked at the course workload. We were not able to get specific enrollment data for any of the courses, so we can only see what is offered. Therefore, we analyzed the

workload in terms of hours and found the mean, median, and the mode of the data. The range is from zero or "not specified," to a course that requires 16-20 hours of work per week. The hourly workload is plotted on the vertical axis ranging from zero to 20, and the 198 courses are plotted along the horizontal axis. See figure 14.

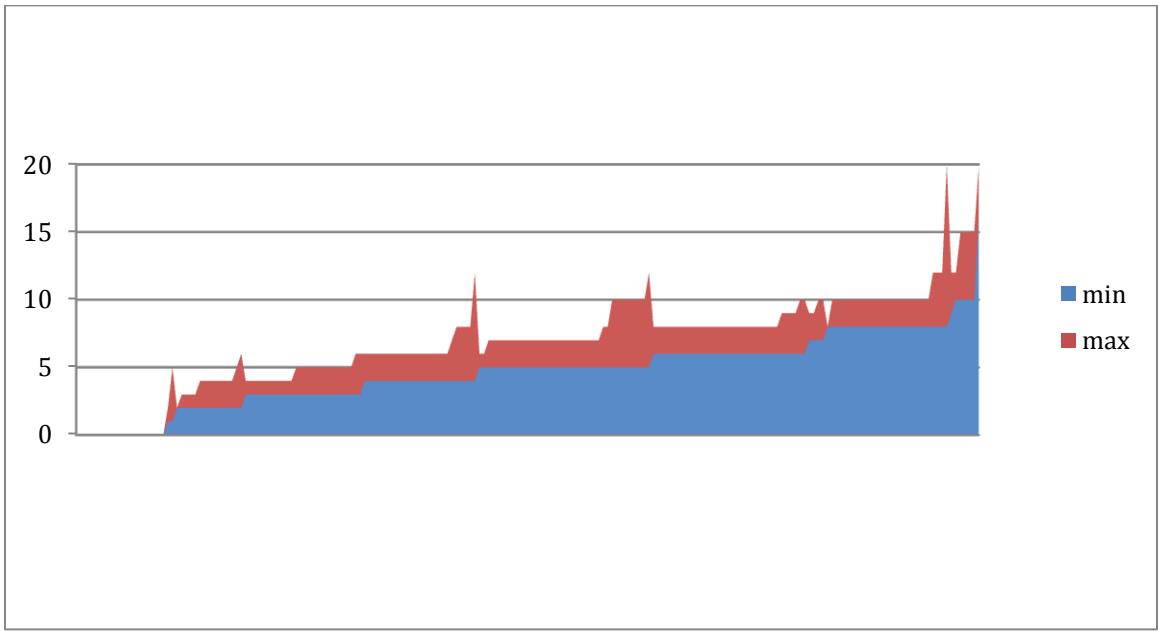

Figure 14

The median for the minimum hours per week workload is 5, and the median for the maximum hours per week is 7. The mode for the minimum hours per week is 5, and the mode for the maximum hours per week is 8. The mean for the minimum hours per week is 4.661, and the maximum is 6.823. See table 1.

Median of the minimal workload	5	Median of the maximum workload	7
Mode of the minimum workload	5	Mode of the maximum workload	8
Mean of the minimum workload	4.661616162	Mean of the maximum workload	6.823232323

Table 1

Udacity's enrollment is open, and according to their website that means a student can take as long as they want to complete a course. Since Udacity courses are made up of distinct units, and each unit is designed to provide a week's worth of instruction and homework, we would need to survey students who took these courses on a weekly correlation in order to gather data to compare it with Coursera.

On the other hand, EdX courses do list their workload in terms of hours per week, and eight out of nine courses give a figure instead of a range. These classes require 10, 12, or 15 hours of work per week. The ninth course, CS50x: Introduction to Computer Science I, lists it's "estimated effort" in a description form: "8 problem sets (15 - 20 hours each), 2 quizzes, 1 final project." Both Udacity and edX seem to require a heavier workload because of the technical nature of their course offerings.

Results & Discussion

With regard to the analysis of the course offerings by discipline, we found that Coursera's courses were mostly interdisciplinary in nature. According to Flynn and Vredevoogd, an emerging trend in academia in the U.S. is interdisciplinary studies programs (2010). Coursera courses follow this trend by offering more interdisciplinary courses and research. We believe this finding shows that Coursera is offering students cutting-edge ideas and education that is current and consistent with brick-and-mortar academia. In contrast with edX and Udacity's limited offerings, Coursera seems to be a much more versatile and diverse online learning environment.

The fact that these courses include an introductory video shows a professor's willingness to share their way of thinking about the subject. Posting these videos to YouTube illustrates the professor's openness and commitment to online education, and perhaps to the greater idea that

education is a basic human right. This is opposed to the sentiment that only students who pay tuition are able to access the insider information that the professor synthesizes for them. We feel that the inclusion of a syllabus also shows a professor's openness and willingness to share.

When we looked at whether outside software, websites, textbooks, or even prerequisites are required to takes these courses, what we really are interested in is whether Coursera, as an information environment, is fulfilling it's mission to open education for all. Software, texts, and even prior coursework can be costly, and thus a barrier to furthering one's education. This consideration is important because for some students it is challenging enough to find a computer with Internet access. Some students may be prohibited from enrolling in a course because of the outside website or software requirements. For example, if a student is using a public computer at a library, they may not be allowed to browse the outside websites or download software to the computer they are using.

We looked at workload to see how demanding these courses would be on the average student in terms of hours per week. In general, the computer science, science, and math courses have a heavier workload in terms of hours, but we found that courses in these categories also had zero or low workloads. We also found Economics & Finance, Humanities & Social Sciences, and Health and Society & Medical Ethics courses requiring anywhere from eight to 12 hours of work. The average course requires 4.6 to 6.8 hours of work per week, which when contrasted with edX's 10-15+ hours per week, seems much more attainable and reasonable.

For our qualitative research, we each enrolled in a course and spent some time getting to know the delivery platform. Most of the courses included video lectures, quizzes, discussion forums, meet-ups, pre-course survey, course logistics, and assignments. We found that most of these features were user friendly, and all easily accessible in a left sidebar menu that provides

easy navigability. In general, we also felt that the videos were presented in a way that we could understand. We liked that the majority of videos were presented in 10 to 15 minute intervals, allowing for more flexibility than a traditional classroom setting.

The forums have pre-set topical discussion threads like, General Discussion, Study Groups, Lectures, Assignments, Course Material Feedback, and Technical Feedback. Beneath these topic headings appears the latest forum activity that pulls from all topical threads and ranks them in order of most recent activity to oldest activity. In an evaluation of online learning, studies found that a tool or feature prompting students to reflect on their learning was effective in improving outcomes (U.S. Department of Education, 2010). We looked to the lecture and assignment forums to fulfill this role; however, we were not impressed with the usability of this feature. In one course, Writing in the Sciences, there are 45 pages of forum threads. See figure 15. Unless one is constantly monitoring the forum for updates, this seems like a cumbersome way of sharing information. On the other hand, we enrolled in these courses while they were already in process, so perhaps had we been participating from the beginning we would have observed and participated in the forums as they evolved.

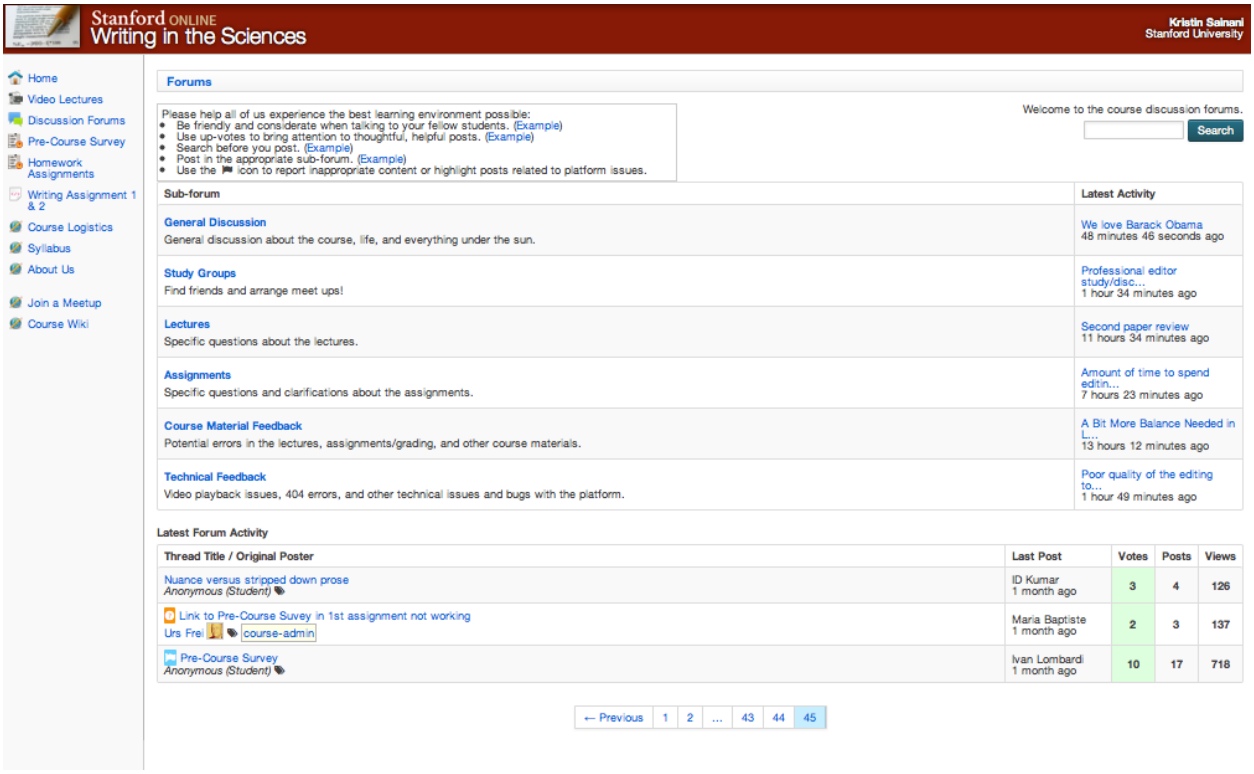

Figure 15

The forums do promote collaboration and online peer-review. Plagiarism is a topic that came up in the Writing in the Sciences course. In one particular thread, a student posted "despite the [professor's] instructions, I have not deducted marks for plagiarism." Immediately her peers pointed out that plagiarism is not acceptable, and warrants a grade of 0. They did so in such a way that followed the advice of being friendly and considerate when talking to fellow students.

While the forums do promote collaborative learning, there is also the chance for off-topic discussions such as the recent "We love Barack Obama" activity under General Discussion. In this particular thread, the instructor posted "though we should stick to course-related topics in general, I appreciate the sentiment here! :)." Another example of where the forums could be improved is the lack of moderation. There were a handful of topics in the forum discussions that had no replies. It's a lot harder to have a question ignored if you ask it out loud in a classroom. This would be prevented with better moderation.

In order to gain more insight to the classroom interface and what goes into conducting a MOOC we spoke to Professor Al Filreis about his course on modern and contemporary American poetry, which is known as ModPo in Coursera. Based on the pre-course survey, approximately 35,000 people are registered for his course, and of those 49% are international and 51% are from the United States (A. Filreis, personal communication, November 13, 2012). These numbers certainly reify the global reach and impact discussed earlier.

Professor Filreis has taught variations of his poetry course in other online settings, so conceptually it was easy to translate the course into an online format. Utilizing the platform as a content provider, however, was not ideal. "Learning the platform was like wrestling with an angel; actually more like wrestling with a mud wrestler. The platform was in beta mode [when the course started], but it's getting better" (A. Filreis, personal communication, November 13, 2012).

ModPo is a particularly unique course offering in Coursera, since there are elements integral to the pedagogy of his course that could not be compromised. One example of this is the video lecture. "I never lecture in my courses." Instead, he gets together six or seven students at the Kelly Writers House, and turns the video "lecture" into a small seminar, thus providing the online student with a sense of being in a classroom and engaged with the discussion. "There is so much interaction going on in ModPo – it is mostly discussion oriented" (A. Filreis, personal communication, November 13, 2012).

Having joined the course and perused some of the discussion boards, it is easy to see that the students are engaged and involved, and much of that has to do with the dynamic teaching style of Professor Filries and the quality of the content. He indicated that with the combined help of 9 teaching assistants, they all engage to help shape the extensive discussions with the students,

and address every post. “We take our involvement in the discussions seriously” (A. Filreis, personal communication, November 13, 2012). Although they are very involved in the discussing the course materials, he and his TA’s moderate the discussions boards very lightly. There have been a couple of instances where he’s had to email someone directly to address inappropriate behavior on the discussion boards, but Professor Filreis indicated that the majority of the students keep themselves in check.

When asked about the peer assessment process and its effectiveness, Professor Filries indicated that “If I had the time to evaluate everyone’s work completely…I would have more to say and more constructive things to say” than what they get from peer reviews. “But in ModPo, people get between 4 and 9 peer reviews.” He went on to say that because of the participation of the class, and the number of peer reviews, once the anomalies are discounted, “actually, people get more and more accurate responses through the peer review system. If you’re getting 6 responses, you still get more feedback than you normally would, unless it was a [writing] workshop.” When asked how teaching ModPo in Coursera compared to previous online teaching experiences: “Well, with 35,000 students it doesn’t compare to anything. It’s stupendous in terms of the amount of people” (A. Filreis, personal communication, November 13, 2012).

Conclusions

Throughout our examination of the Coursera information environment, we have found a common theme through both the literature and our own exploration of the interface—the high degree of accessibility. At the heart of Coursera’s mission is the idea of bringing education to people who would not otherwise have the opportunity to learn these skills, whether that is via a wider range of courses in subjects not taught in every student’s local institutions, offering college

level courses for a price—or lack thereof—that brings them in reach of those who cannot afford a college education, or through delivering the content in a format that fits more neatly into the lives of prospective students who simply can't fit a conventional university course into their already busy schedules. A review of the literature available regarding Coursera turns up a number of success stories—of students like Askhat Murzabayev who were able to learn new things and open up new opportunities, of professors like Brian Caffo who have been able to reach more students than they ever would have thought possible, and of new ground being broken as people redefine their definitions of what constitutes higher education in a rapidly changing digital age. MOOC's are beginning to find their place as university policies and even state laws change to include them in education alongside traditional college courses; what once was a smaller and more closed information environment—that of higher education—is exploding, reaching out to people who never before had the opportunity to experience it.

Although Coursera is not the only player in the MOOC environment, a quantitative examination of its course catalog easily shows why it has garnered so much attention since its inception: it is multidisciplinary where its closest comparisons, edX and Udacity, are heavily focused on computer science. Coursera offers approximately ten times as many courses as either of these other programs, and it covers a range of subjects going beyond the expected computer science and programming courses and including other sciences, the humanities, education, and more; in offering more courses over a wider area, Coursera takes the concept a step further in making it open, accessible, and *appealing* to an audience that may be looking for something other than computer skills. In addition to opening up the MOOC environment in terms of what it has to offer prospective students, Coursera also holds true to the driving idea of open education by making itself financially accessible, with a mere 2% of courses requiring outside software that

must be purchased, and only 6% requiring the purchase of a textbook or other materials. The most frequent "expense" associated with Coursera courses may come in the nearly half of courses that have some form of education or programming skills as a prerequisite to learning the material—although it is worth noting that some of these potential costs may be education or skills that can also be learned for free via other Coursera courses. Although in many cases there are suggested or supplemental materials that may be found at the student's own expense, Coursera goes the distance to ensure that its free courses are indeed free, and that additional costs are not simply hidden in materials or the prerequisites.

The format itself is easily underrated, but a critical part of what makes Coursera so innovative. Video lectures help students find a sense of rapport with their instructors despite the distance, but their presentation in short, manageable chunks allows students to tailor their intake of information to suit both their attention spans and their schedules—a flexibility not afforded by traditional lecture attendance, where the inability to sit through or stay for several hours in a non-negotiable time slot could be enough to render a class impossible for some prospective students. Discussion forums enable students to communicate with each other, professors, and teaching assistants; although some questions seem to be left unanswered (a flaw that may be as simply combated as to improve TA moderation and explicitly require that they check up on posts with no replies), the forums are generally lively, active, and filled with student discussion and interaction, bringing far more perspectives to the material than a traditional lecture with time for a few student questions could ever hope to achieve—and making it easier for every student to have a chance at making their voice heard, although the high activity levels may prove intimidating in their own way, and the forums require close monitoring to be used to their fullest potential. Although the format does leave Coursera open to justifiable concerns about plagiarism,

some students have taken it on themselves to speak against it and call out perpetrators on the forums; while they may be some work yet to be done to ensure that work can be judged for cheating as effectively as in traditional courses, the positive student response to combating plagiarism is a hopeful sign. The classroom interface is easily navigable and provides (in most cases) everything needed from a single sidebar, bringing the course together in a user-friendly way that requires little extra effort to learn and utilize and allowing students to focus on the material. It isn't a perfect format—as perhaps nothing can be—but it is generally effective.

That is, perhaps, the best simple description of what Coursera has accomplished so far: it isn't perfect, as nothing can be, but it is generally effective. Overall, an examination of the Coursera information environment shows that it is effective at its mission of bringing college level education to a wider audience through a unique new package; it circumvents the potentially prohibitive costs of traditional higher education, offers its material in a format that is more flexible with regards to learning styles and busy schedules, and does so while offering a wider range of material than either of its closest comparable programs, edX and Udacity. Although the system is not without some flaws, it has plenty of benefits to balance them out, and its success right out the gate despite the relative newness of the platform suggests that if it can work out these flaws and improve on the foundation it has already built, Coursera has truly amazing potential to bring higher education within the reach of anyone with a working Internet connection.

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